

**TOXECON<sup>TM</sup> RETROFIT FOR MERCURY AND  
MULTI-POLLUTANT CONTROL ON THREE  
90-MW COAL-FIRED BOILERS**

**Quarterly Technical Progress Report  
Reporting Period: January 1, 2005 – March 31, 2005**

**Prepared by  
Richard E. Johnson  
Wisconsin Electric Power Company  
333 West Everett Street  
Milwaukee, WI 53203**

**April 29, 2005**

**DOE Cooperative Agreement No. DE-FC26-04NT41766**

**Theodore J. McMahon  
USDOE Contracting Officer's Representative**

## **DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

## ABSTRACT

With the Nation's coal-burning utilities facing tighter controls on mercury pollutants, the U.S. Department of Energy is supporting projects that could offer power plant operators better ways to reduce these emissions at much lower costs. Sorbent injection technology represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers. It involves injecting a solid material such as powdered activated carbon into the flue gas. The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with the mercury attached is then collected by a particulate control device along with the other solid material, primarily fly ash.

We Energies has over 3,200 MW of coal-fired generating capacity and supports an integrated multi-emission control strategy for SO<sub>2</sub>, NO<sub>x</sub>, and mercury emissions while maintaining a varied fuel mix for electric supply. The primary goal of this project is to reduce mercury emissions from three 90-MW units that burn Powder River Basin coal at the We Energies Presque Isle Power Plant. Additional goals are to reduce nitrogen oxide (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), and particulate matter (PM) emissions, allow for reuse and sale of fly ash, demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment, and demonstrate a process to recover mercury captured in the sorbent. To achieve these goals, We Energies (the Participant) will design, install, and operate a TOXECON™ system designed to clean the combined flue gases of units 7, 8, and 9 at the Presque Isle Power Plant.

TOXECON™ is a patented process in which a fabric filter system (baghouse) installed downstream of an existing particle control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. For this project, the flue gas emissions will be controlled from the three units using a single baghouse. Mercury will be controlled by injection of activated carbon or other novel sorbents, while NO<sub>x</sub> and SO<sub>2</sub> will be controlled by injection of sodium-based or other novel sorbents. Addition of the TOXECON™ baghouse will provide enhanced particulate control. Sorbents will be injected downstream of the existing particle collection device to allow for continued sale and reuse of captured fly ash from the existing particulate control device, uncontaminated by activated carbon or sodium sorbents.

Methods for sorbent regeneration, i.e., mercury recovery from the sorbent, will be explored and evaluated. For mercury concentration monitoring in the flue gas streams, components available for use will be evaluated and the best available will be integrated into a mercury CEM suitable for use in the power plant environment. This project will provide for the use of a control system to reduce emissions of mercury while minimizing waste, from a coal-fired power generation system.

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	1
INTRODUCTION .....	2
Project Objectives .....	2
Scope of Project .....	2
EXPERIMENTAL .....	3
RESULTS AND DISCUSSION .....	4
Task 4 – Balance of Plant (BOP) Engineering .....	4
Task 5 – Process Equipment Design and Major Equipment Procurement .....	5
Task 6 – Prepare Construction Plan.....	5
Task 7 – Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment.....	5
CEM Component Update.....	6
CEM Component Evaluation.....	9
Site Progress.....	12
Task 8 – Mobilize Contractors.....	13
Task 9 – Foundation Erection.....	13
Task 10 – Erect Steel, Baghouse and Ductwork.....	13
Task 11 – Balance of Plant Mechanical and Civil/Structural Installation.....	13
Task 12 – Balance of Plant Electrical .....	14
Task 13 – Pre-Op Testing .....	14
Task 14 – Start-up.....	14
Task 15 – TOXECON™ Testing for Mercury Control.....	14
Filter Cake Sorbent Screening Device (SSD).....	15
Semi-Continuous Mercury Analyzer .....	16
Test Matrix and Schedule .....	17
Task 16 – TOXECON™ Testing for NO <sub>x</sub> and SO <sub>2</sub> Control.....	17
Task 17 – Carbon – Ash Management System.....	17
Task 18 – Revise Design, Specs, Prepare O&M Manual .....	17
Task 19 – Reporting, Management, Subcontracts, Technology Transfer .....	17
Items Delivered During the Quarter .....	18
CONCLUSION.....	18
REFERENCES .....	18
PROJECT PHOTOS .....	18

Appendix A - Bid Package Elements.....	A-1
Appendix B - Statement of Project Objectives .....	B-1
A. Project Objectives .....	B-2
B. Scope of Project .....	B-3
C. Tasks to be Performed.....	B-3
D. Deliverables .....	B-14
E. Briefings .....	B-15

## EXECUTIVE SUMMARY

Wisconsin Electric Power Company (We Energies) signed a Cooperative Agreement with the U.S. Department of Energy (DOE) in March 2004 to fully demonstrate TOXECON™ for mercury control at the We Energies Presque Isle Power Plant. The primary goal of this project is to reduce mercury emissions from three 90-MW units (units 7, 8, and 9) that burn Powder River Basin (PRB) coal. Additional goals are to reduce nitrogen oxide (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), and particulate matter (PM) emissions, allow for reuse and sale of fly ash, demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment, and demonstrate a process to recover mercury captured in the sorbent.

We Energies has teamed with ADA-ES, Inc., (ADA-ES) and Cummins & Barnard, Inc., (C&B) to execute this project. ADA-ES is providing engineering and management on the mercury measurement and control systems. Cummins & Barnard is the engineer of record and will be responsible for construction, management, and start-up of the TOXECON™ equipment.

This project was selected for negotiating an award in January 2003. Preliminary activities covered under the "Pre-Award" provision in the Cooperative Agreement began in March 2003. This quarterly report summarizes progress made on the project from January 1, 2005, through March 31, 2005. During this reporting period, work was conducted on Tasks 4, 5, 6, 7, 8, 9, 10, 11, 12, 15 and 19.

During the quarter work was completed on Budget Period 1 activities and work on Budget Period 2 activities commenced.

## INTRODUCTION

DOE awarded Cooperative Agreement No. DE-FC26-04NT41766 to We Energies to demonstrate TOXECON™ for mercury and multi-pollutant control, a reliable mercury continuous emission monitor (CEM), and a process to recover mercury captured in the sorbent. Under this agreement, We Energies is working in partnership with the DOE.

Quarterly reports will provide project progress, results from technology demonstrations, and technology transfer information.

## Project Objectives

The specific objectives of this project are to demonstrate the operation of the TOXECON™ multi-pollutant control system and accessories, and:

- achieve 90% mercury removal from flue gas through activated carbon injection,
- evaluate the potential for 70% SO<sub>2</sub> control and trim control of NO<sub>x</sub> from flue gas through sodium-based or other novel sorbent injection,
- reduce PM emission through collection by the TOXECON™ baghouse,
- recover 90% of the mercury captured in the sorbent,
- utilize 100% of fly ash collected in the existing electrostatic precipitator,
- demonstrate a reliable, accurate mercury CEM suitable for use in the power plant environment, and
- successfully integrate and optimize TOXECON™ system operation for mercury and multi-pollutant control.

## Scope of Project

The "TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers" project will be completed in two Budget Periods. These two Budget Periods are:

Budget Period 1: Project Definition, Design and Engineering, Prototype Testing, Major Equipment Procurement, and Foundation Installation.

Budget Period 2: CEM Demonstration, TOXECON™ Erection, TOXECON™ Operation, and Carbon Ash Management Demonstration.

As indicated by the title, Budget Period 1 initiates the project with project definition activities including NEPA, followed by design, which includes specification and procurement of long lead-time major equipment, and installation of foundations. In addition, testing of prototype mercury CEMs will be conducted. Activities under Budget Period 1 were completed during the quarter.

Following in Budget Period 2, the TOXECON<sup>TM</sup> system will be constructed and operated. Operation will include optimization for mercury control, parametric testing for SO<sub>2</sub> and NO<sub>x</sub> control, and long-term testing for mercury control. The mercury CEM and sorbent regeneration processes will be demonstrated in conjunction with the TOXECON<sup>TM</sup> system operation. Work on Budget Period 2 tasks began during the quarter.

Each task is described in the Statement of Project Objectives (SOPO) that is part of the Cooperative Agreement. For reference in this and future quarterly reports, the original SOPO for this project can be found in Appendix B.

## **EXPERIMENTAL**

None to report.

## RESULTS AND DISCUSSION

Two budget periods have been established for the project. Work performed during the quarter transitioned from Budget Period 1 into Budget Period 2.

### **Task 4 – Balance of Plant (BOP) Engineering**

Design work continued this quarter on the baghouse, compressed air, misc. platforms, auxiliary electrical systems, electrical construction contract and DCS I/O development.

Major design efforts during this period were in the following areas:

- Review of baghouse vendor drawings and electrical detail design continued.
- Misc. equipment pads and foundations are in final stages of completion.
- Ductwork and major structural steel design was completed. Miscellaneous steel design including platforms was completed.
- Booster fan vendor drawing reviews were completed.
- Electrical system balance of plant design and 2.4kV electrical system upgrade was completed.
- Additional electrical work included evaluating and awarding the 2.4kV switchgear, and 480V MCC's.
- Preparation of the electrical construction package specification was completed and issued for bids.
- Completed design on air compressor and air dryer and issued for bids, bids were evaluated and a contract awarded.
- Completed design on ductwork expansion joints and issued for bids, bids were evaluated and a contract awarded.
- PAC System scope of work and design was finalized and fabrication is in progress.
- Control engineering work including DCS continued with the definition of I/O for the project, draft of logic, and defining required field instrumentation.
- The superstructure construction contract package specification and drawings were completed and issued for bids in two packages. One package was for the erection of the ductwork under the baghouse, the second package was for all other superstructure

work. Bids were evaluated and both contracts awarded to the same contractor. The contractor mobilized on February 18, 2005.

- Development of drawings and specification for the Balance of Plant Electrical Construction Package and issuance for bids required a significant effort in the electrical and instrumentation areas.

The following major construction contract packages were awarded during this period.

Superstructure Phase 1 ductwork erection	February 11, 2005
Superstructure Construction Package	March 3, 2005

## **Task 5 – Process Equipment Design and Major Equipment Procurement**

The following major equipment were awarded during this period.

Electrical 2.4kV Switchgear	February 1, 2005
Electrical 480V MCC's	March 7, 2005
Electrical Med. Voltage Starters	March 7, 2005
Electrical Reserve Bus Duct	February 22, 2005
Compressed Air Package	February 4, 2005
Ductwork Expansion Joints	January 27, 2005
PAC equipment (NORIT)	Jan. 14, 2005

Major efforts during this period were in the following areas:

- Procurement efforts associated with the above procurements represented most of the work during this period.
- A bid package was prepared by C&B for each item of equipment. Important design features, performance requirements, functional characteristics, and specifications are presented in Appendix A. Also included in the Appendix is an overview of the important factors that went into evaluating and selecting the vendors.
- Review of WAPC drawing submittals.

## **Task 6 – Prepare Construction Plan**

The construction plan was finalized and issued January 26, 2005. This task is considered complete.

## **Task 7 – Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment**

Activities under Task 7 will be performed in both Budget Periods 1 and 2. The overall goal of this task is to have a production-grade, reliable, certified mercury CEM installed and

operational for use in the TOXECON evaluation. ADA-ES has teamed with Thermo Electron to on this task.

### CEM Component Update

Advancements were made on each of the components during this report period. A schematic of the Thermo Electron mercury CEM showing each of the four key components, sample extraction probe, sample converter, mercury analyzer and the calibration module, can be seen in Figure 1.

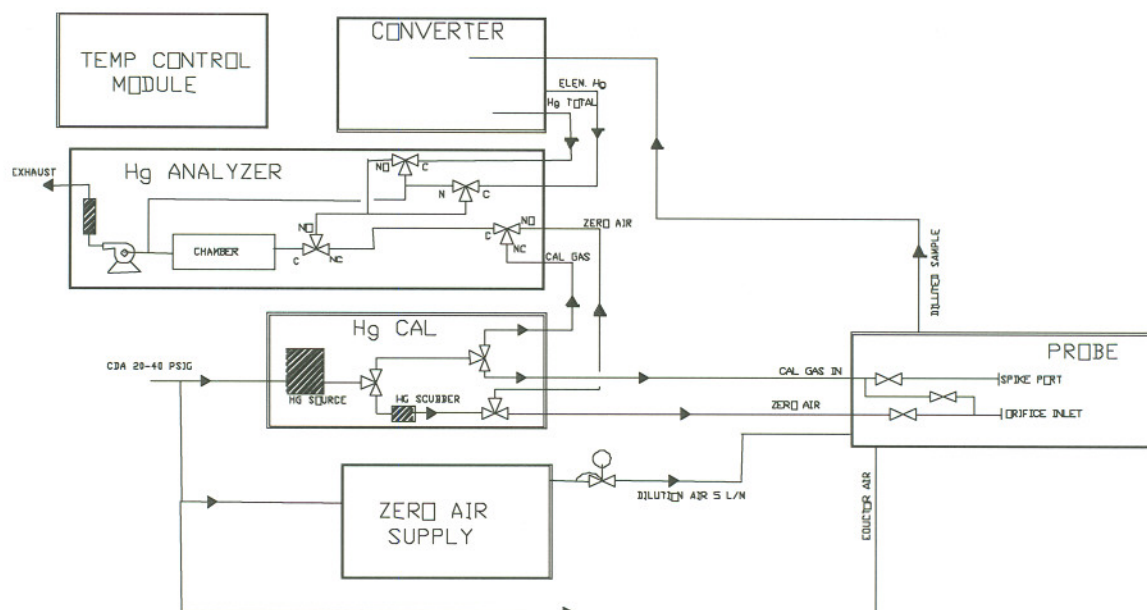


Figure 1. Schematic of prototype mercury CEM.

A schematic and photograph of the extraction probe are shown Figure 2. The extraction probe uses an inertial filter to separate a particulate-free vapor-phase sample while minimizing the interactions with fly ash, which can cause sampling artifacts. Compressed, dry mercury-free dilution is delivered to an eductor. A critical orifice is connected between the vacuum port on the eductor and the inertial probe. To maintain a fixed sample flow rate, the sample is immediately diluted with the dilution air resulting in a dilution ratio between 25:1 to 100:1, depending on the size of the critical orifice. The dilution ratio is predetermined based on flue gas conditions and operator preference. All of the internal surfaces that are exposed to sample gas have a glass coating, to prevent unwanted chemical reactions with the mercury. Calibration gas can be introduced either upstream of downstream of the inertial filter.

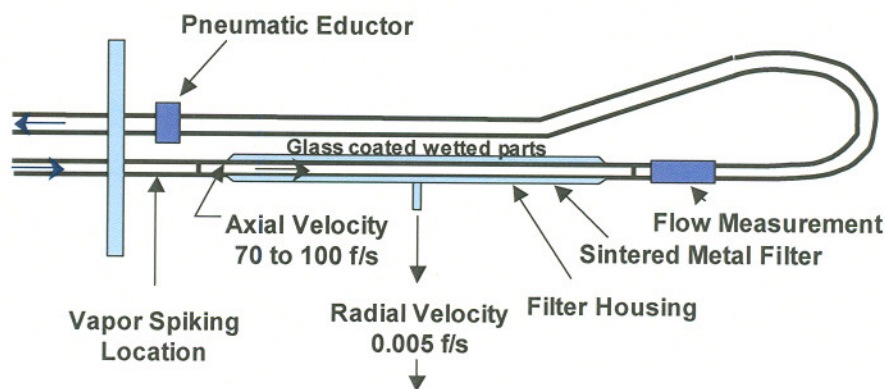
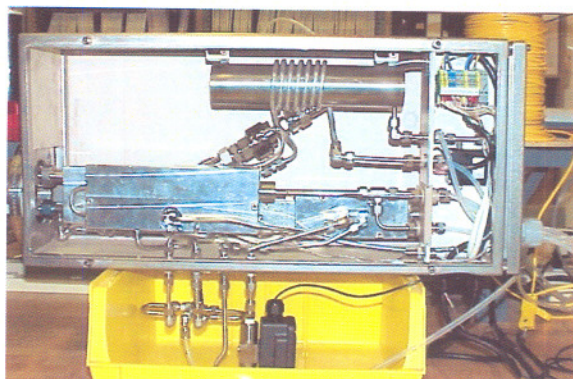


Figure 2. Mercury CEM extraction probe.

The converter module converts oxidized mercury to elemental mercury for a total vapor phase measurement, or it scrubs oxidized mercury to deliver only elemental mercury to the analyzer when a speciated measurement is desired. A great deal of progress was made on the design of the converter since last September. The proprietary design combines high temperature ( $>750^{\circ}\text{F}$ ) and a chemical reaction to achieve the conversions. Figure 3 presents data from a laboratory test of the converter when known concentrations of oxidized ( $\text{HgCl}_2$ ) and elemental mercury were introduced into the system. These data also included a test with air that had no measurable mercury.

Mercury is measured directly in the analyzer using Cold Vapor Atomic Fluorescence technology. Because the sample is diluted, it has low moisture, is relatively non-reactive and therefore has minimal interference from other gases. Currently the detection limit is  $1 \text{ ng/m}^3$  ( $\sim 0.1 \text{ PPT}$ ) with no cross interference from  $\text{SO}_2$  has been observed. Figure 4 is a simplified graphic of the measurement cell, showing the high intensity mercury lamp and the photo multiplier tube used measuring the fluorescence from the mercury molecules.

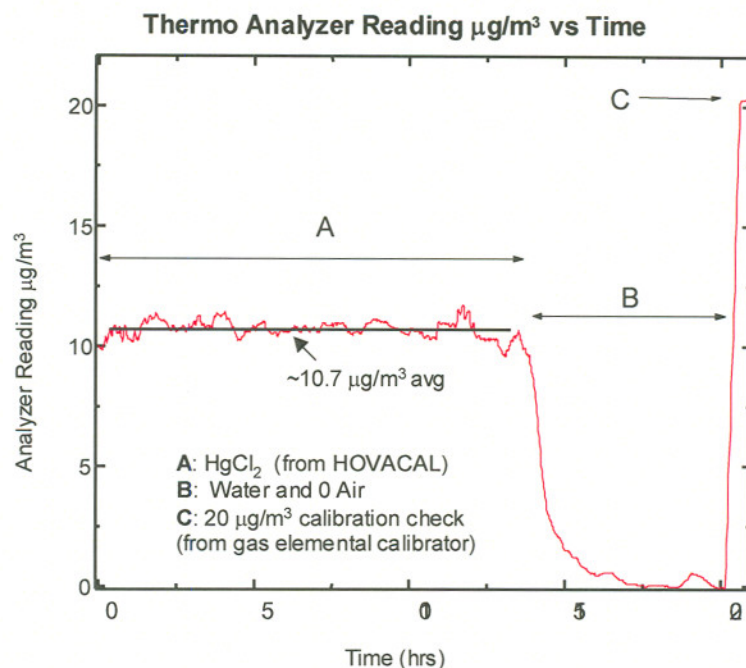


Figure 3. Laboratory data showing the performance of the converter on oxidized and elemental mercury.

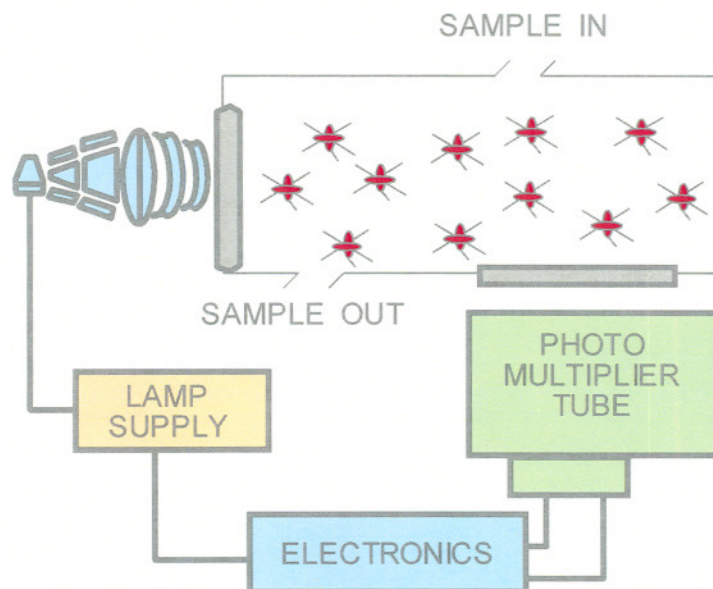


Figure 4. Analyzer measurement cell, high intensity mercury lamp and photo multiplier tube that measures the atomic fluorescence of the mercury molecules.

A vapor phase elemental mercury calibrator is used to spike mercury either upstream or downstream of the inertial separator. This range allows the operator to directly calibrate the

analyzer at post-dilution concentrations and dynamically spike into the extraction probe. The technology uses a Peltier Cooler/vapor pressure control and a mass flow controller. The calibrator can deliver a concentration of elemental mercury between 0.1 to 300 mg/m<sup>3</sup>.

In addition to the four major components, there is also a probe control box and a module that supplies zero air. These two pieces of support equipment are each housed in a separate box, seen in Figure 5, that can fit into a standard CEM rack. The probe control box is used for controlling automatic calibration and dynamic spiking of elemental mercury. Zero air supplies clean air to the calibrator and to the dilution eductor.



Figure 5. Probe control box and zero air supply unit.

### ***CEM Component Evaluation***

ADA-ES's role is to evaluate CEM components in real flue gas and provide feedback on operation and performance to Thermo Electron. In general, test sites are chosen to coincide with other mercury measurement testing being conducted by ADA-ES. This allows for real-time comparison of the new components with data from proven Semi-Continuous Emission Monitors (S-CEMs). During this reporting period, ADA-ES evaluated components at a plant firing a western bituminous coal and a plant firing a medium sulfur, washed eastern bituminous coal. In addition, Thermo Electron joined a round robin test of mercury CEMs coordinated by EPA's Office of Air Quality Planning and Standards (OAQPS) at Louisville Gas and Electric's Trimble County Station and continued component evaluation at the Brayton Point Station.

ADA-ES was granted permission to set-up a test-bed at a local power plant that fires a western bituminous coal. Testing at this site began on January 21 and continued until March 14. Because of plant outages, the actual time available for testing was limited. For these tests, an updated version of the converter was evaluated. Overall, the mercury CEM performed well with little drift in the response to either zero gas or span gas. The measurements from the Thermo analyzer tracked well with the ADA-ES analyzer, measuring mercury concentrations between 3 and 7 µg/Nm<sup>3</sup>. Because of the limited time available for

testing, the converter was not adequately evaluated and the instrument was moved to a different plant.

Following testing at the plant in the Denver area, the analyzer was installed at a plant in the southeast that fires a medium sulfur, washed bituminous coal. Again, due to unscheduled outages, testing was limited.

Brayton Point was chosen as a test site because this plant fires a bituminous coal that should challenge the converter and it is close to Thermo's office, which allows Thermo engineers access to flue gas to quickly evaluate components. ADA-ES does not have a S-CEM set-up at this site. To validate the measurements, Thermo Electron contracted with TRC Corporation to have a set of Ontario Hydro measurements made. The results from these tests are shown in Figure 6. The Ontario Hydro results are identified as "TRC" and the analyzer results as TEI. The analyzer measurements compared well with the manual measurements for both total and speciated mercury. The variation between the two measurement methods was 0.9%, 9.5% and 16.2% for runs 1 through 3.

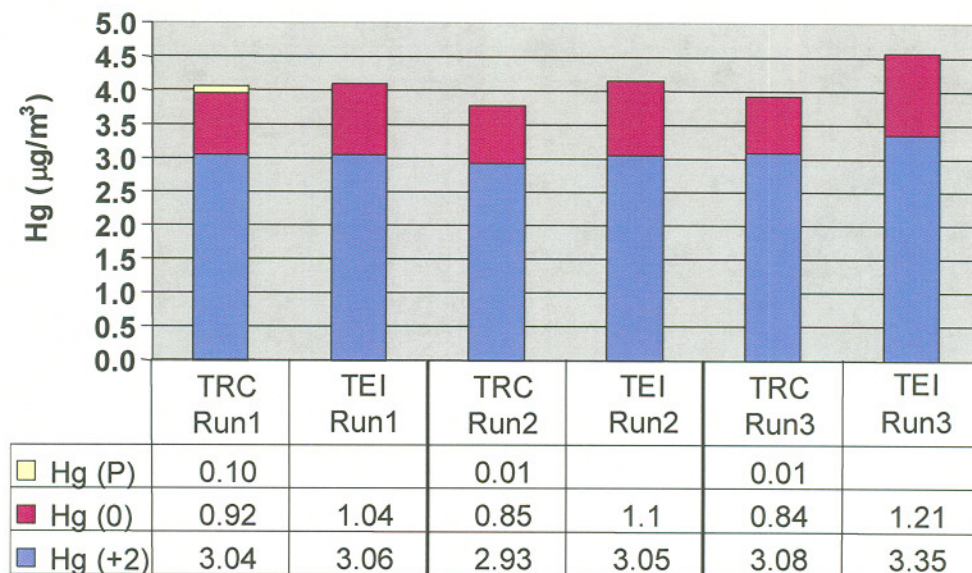


Figure 6. Results from mercury CEM and Ontario Hydro measurements at Brayton Point test bed. Analyzer measurements are identified as TEI and Ontario Hydro as TRC.

Thermo joined a round robin test being conducted by EPA OAQPS at Louisville Gas and Electric's Trimble County Station. An analyzer was installed in late January has been in operation for over fifty days. Preliminary results show that the Thermo analyzer has passed all of the accuracy and reliability tests conducted so far. More information on results will be available from EPA in the near future. RATA (relative accuracy test audit) test results are not yet available.

In April, an analyzer will be made available for another EPA conducted, round robin test. The site for this test is Progress Energy's Cape Fear Station in Moncure, NC.

The prototype analyzer is nearing the point where Thermo Electron is preparing to launch it as a commercial instrument and begin taking orders. It is expected that this announcement will be made in the next quarter.

A summary of past, current and future test sites is presented in Table 1.

**Table 1. Mercury CEM Test Sites**

<b>Test Site</b>	<b>Test Dates</b>	<b>Fuel/Configuration</b>	<b>Components Tested and Development Stage</b>
Sunflower Electric Holcomb Station	July and August 2004	PRB/Spray Dryer and Fabric Filter	Extraction Probe - Alpha Analyzer - Alpha Calibrator - Prototype
Unidentified high sulfur site	August 2004	High sulfur, high ammonia, high temperature flue gas	Analyzer - Alpha Converter - Prototype
Ameren's Meramec Station	October 2004	PRB/ESP	Extraction Probe - Alpha Analyzer - Alpha Calibrator - Alpha Converter - Prototype
U.S. Gen's Brayton Point	October – December 2004	Low sulfur Bituminous/ ESP	Extraction Probe - Beta Analyzer - Beta Calibrator - Alpha Converter - Prototype
Western Bituminous Site	January – February 2005	Low sulfur, western Bituminous/FF	Beta version of all components
Eastern Bituminous Site	March 2004	Eastern, medium sulfur/ESP	Beta version of all components
EPA Test Site Trimble County	February – June 2005	Low sulfur bituminous/ESP	Beta version of all components
EPA Test Site Cape Fear	April – June 2005	Low sulfur bituminous/ESP	Beta version of all components
We Energies Presque Isle	June – September 2005	PRB/Hot-Side ESP	Beta version of all components

### ***Site Progress***

Mercury removal will be measured across the TOXECON™ baghouse with two CEM's. The inlet measurement will be made upstream of carbon injection. The outlet extraction probe will be installed in a set of test ports immediately downstream of the baghouse, before the duct splits into three smaller ducts.

The extraction location at the inlet was finalized and there will be three extraction points, one in each of the three ducts coming out of the APH's from Units 7, 8, and 9. These samples will be combined to give an average inlet mercury concentration. The port locations are immediately below the air preheater and before the ID fan on each unit. A refurbished CEM

shelter is located near the extraction location on Unit 8. A new CEM shelter was purchased for the outlet analyzer. This shelter will be placed in the enclosed area under the baghouse.

## **Task 8 – Mobilize Contractors**

CaTS is proceeding with managing the field construction work. Staff during this period included the construction manager, construction engineer, a safety coordinator, electrical coordinator, and an administrative clerk.

The substructure contractor completed the fan and motor pedestal foundations, ash silo foundation and all of the ductwork support steel foundations. All major foundations were completed by January 21, 2005.

All construction work was shut down for the winter between January 22, 2005 and February 18, 2005.

The superstructure contractor Jamar mobilized on February 18, 2005 for receiving and erecting the ductwork on the baghouse foundation. Wheelabrator Air Pollution Control baghouse erection contractor mobilized the last week of February.

## **Task 9 – Foundation Erection**

All Major foundation work by Boldt Construction Co. was completed during this period, as noted below. Only minor equipment housekeeping pads and grouting remain to be done.

<b>Activity</b>	<b>Status</b>
Baghouse foundation	Completed December 10, 2004
Booster fan mat foundation	Completed January 5, 2005
Fan and motor pedestals	Completed January 20, 2005
PAC silo foundation	Completed December 24, 2004
Ash silo foundation	Completed January 18, 2005
Ductwork support foundations	Completed January 21, 2005

## **Task 10 – Erect Steel, Baghouse and Ductwork**

Initial deliveries for baghouse, structural steel and ductwork were received at the site in the middle of February. Erection work for the baghouse and ductwork started this period.

## **Task 11 – Balance of Plant Mechanical and Civil/Structural Installation**

Insulation of ductwork was initiated along with preparation for Unit 8 tie-in.

## Task 12 – Balance of Plant Electrical

Electrical equipment enclosure and baghouse CEM building delivered to site.

## Task 13 – Pre-Op Testing

No work scheduled during this period.

## Task 14 – Start-up

A Preliminary high level start-up plan was provided to We Energies during this period.

## Task 15 – TOXECON™ Testing for Mercury Control

The multi-year evaluation of the TOXECON™ process will be conducted under this task.

As described earlier, mercury will be controlled by injection of activated carbon or other novel sorbents upstream of the baghouse. Full-scale test programs have demonstrated that activated carbon effectively removes mercury on plants firing PRB coals and with flue gas temperatures up to 330°F (DOE Report No 41005R22). However, at temperatures above 350°F, laboratory testing shows the capacity of activated carbon decreases significantly. Figure 7 presents data from laboratory tests of adsorption capacity as a function of temperature.

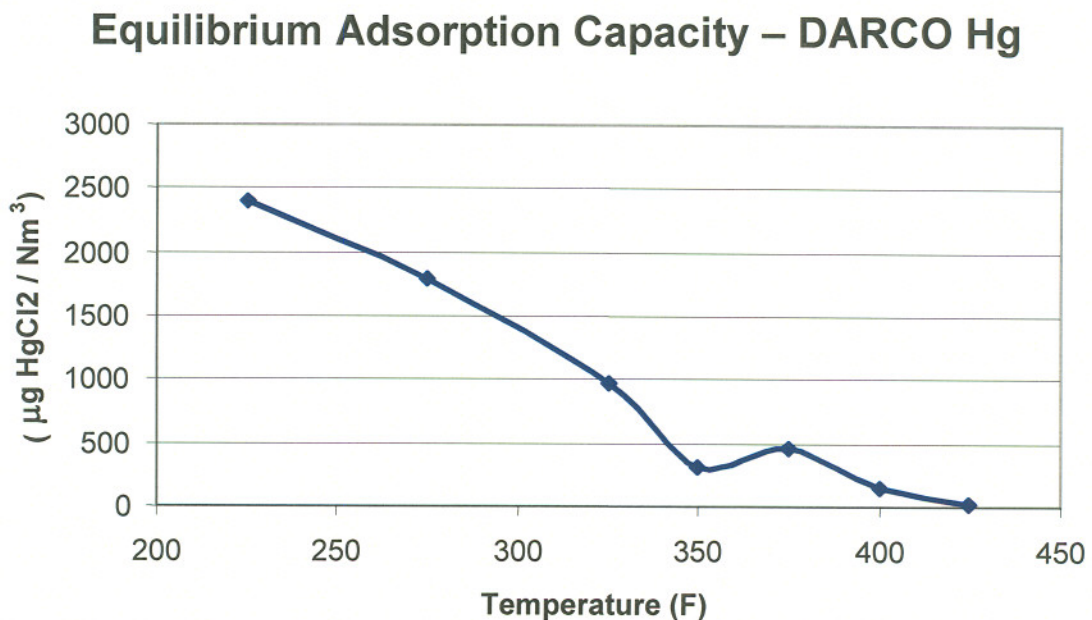


Figure 7. Sorbent Adsorption Capacity vs. Temperature  
(graph developed by URS Corporation).

Currently, flue gas temperatures entering the TOXECON™ baghouse are expected to vary between 330 and 360°F, depending on boiler load and ambient temperature. There is concern about the performance of activated carbon at temperatures above 350°F. At these higher temperatures, more carbon or a different carbon may be required to achieve 90% mercury removal. To understand the impact of operating temperatures on activated carbon and TOXECON™ performance, a test program was designed to characterize mercury capture with Norit Americas (Norit) activated carbons. Testing will be conducted using ADA-ES's Sorbent Screening Device (SSD) on a slipstream of flue gas from Unit 7 or 9.

The objectives of this test are:

1. Characterize performance of Norit's standard activated carbon, DARCO Hg, and Norit's treated activated carbon, DARCO Hg<sub>LH</sub> in a slipstream test at two different activated carbon loadings;
2. Characterize performance of Norit's standard activated carbon, DARCO Hg, and Norit's treated activated carbon, DARCO Hg<sub>LH</sub> in a slipstream test at three different temperatures;

### ***Filter Cake Sorbent Screening Device (SSD)***

ADA-ES' slipstream sorbent test device simulates the sorbent loading to a baghouse and permits comparison of the effectiveness of potential sorbents. Three sorbents are tested in parallel over a period of several hours. The sorbent screening device is an extractive system designed to simulate the gas velocity, temperature, sorbent and ash loading of a baghouse. Photographs of the SSD housing and the individual filters can be seen in Figure 8. A sorbent and ash (or other inert media) mixture is preloaded onto one of three 2-inch substrates to permit direct side-by-side comparison of three samples. In this test ash from Unit 7, 8 or 9 hot-side ESP hoppers will be mixed with the activated carbons.

Flue gas will be extracted from downstream of the hot-side ESP on either Unit 7 or 9 at Presque Isle. It will be possible to test up to eight activated carbons. Fly ash alone will also be tested.

Total vapor-phase mercury concentration is measured at the inlet and three filter outlets of the device with ADA-ES' semi-continuous mercury analyzers. It is expected that each run will last 3 hours or terminated when the outlet mercury concentration equals the inlet mercury concentration (100% breakthrough). The quantity of sorbent loaded on to each filter is calculated to mimic typical baghouse injection rates (0.5 to 3 lb/MMacf).



Figure 8. Sorbent Screening Device.

### ***Semi-Continuous Mercury Analyzer***

A semi-continuous mercury analyzer will be used to provide near real-time feedback during the test and to detect breakthrough. The analyzers consist of a commercially available cold vapor atomic absorption spectrometer (CVAAS) coupled with a gold amalgamation system (Au-CVAAS). ADA-ES has been using a similar system during all mercury control evaluations since 2000 (> 10,000 hours of field operation on ADA-ES programs). A sketch of the system is shown in the Figure 9.

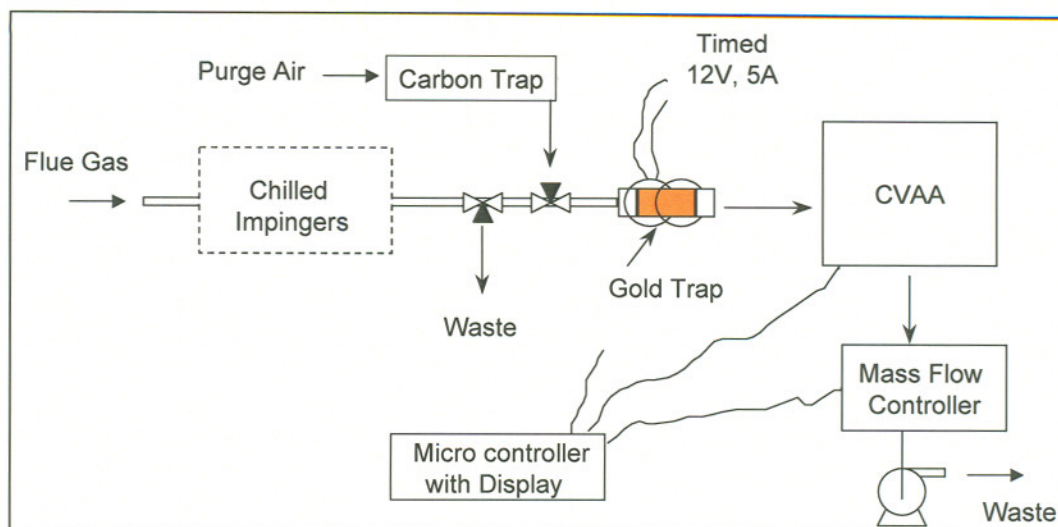


Figure 9. Sketch of Mercury Measurement System.

### ***Test Matrix and Schedule***

Seven days of testing are planned, including one contingency day. Setup of equipment at the site is scheduled to occur on April 19 and 20. Sorbent screening tests are scheduled for April 20–26. The equipment will be demobilized on April 27 and 28.

### **Task 16 – TOXECON™ Testing for NO<sub>x</sub> and SO<sub>2</sub> Control**

No work was done on this task during this period..

### **Task 17 – Carbon – Ash Management System**

No work was done on this task during this period.

### **Task 18 – Revise Design, Specs, Prepare O&M Manual**

No work scheduled during this period.

### **Task 19 – Reporting, Management, Subcontracts, Technology Transfer**

Under this task reports, as required in the Financial Assistance Reporting Requirements Checklist and the Statement of Project Objectives are prepared and submitted. Subcontract management, communications, outreach, and technology transfer functions are also performed under this task.

Of note during the quarter, We Energies received an environmental award from the Operation Action UP group.

### ***Items Delivered During the Quarter***

- Quarterly Technical Progress Report.
- Quarterly Financial Status Report.
- Quarterly Federal Assistance Program/Project Status Report.
- Work began on a Preliminary Public Design Report.
- A Budget Period 1 Review Meeting was held on 2/23/05.
- A Construction Plan was prepared and submitted to NETL.
- An interview was given to Marquette TV station (Channel 6).
- Technical papers and presentations that were discussed during the quarter for future meetings are the DOE Contractor's Review Meeting (July 2005), Reinhold FF/ESP Conference (July 2005), AQV Meeting (September 2005), and PowerGEN (December 2005).

## **CONCLUSION**

This is the fourth Technical Progress Report under Cooperative Agreement No. DE-FC26-04NT41766. Work continued in the TOXECON™ system design and engineering. Construction activities commenced during the quarter. Work continued in the evaluation of components for a mercury continuous emissions monitor system.

## **REFERENCES**

None this reporting period.

## **PROJECT PHOTOS**

The following photos are included showing progress of activities at the site during the reporting quarter:

- Photo 1. Delivery of baghouse hoppers.
- Photo 2. Erection of structural steel for fan enclosure.
- Photo 3. Erection of baghouse structural steel.
- Photo 4. Delivery of Unit #8 diverter damper.



Photo 1. Delivery of baghouse hoppers.

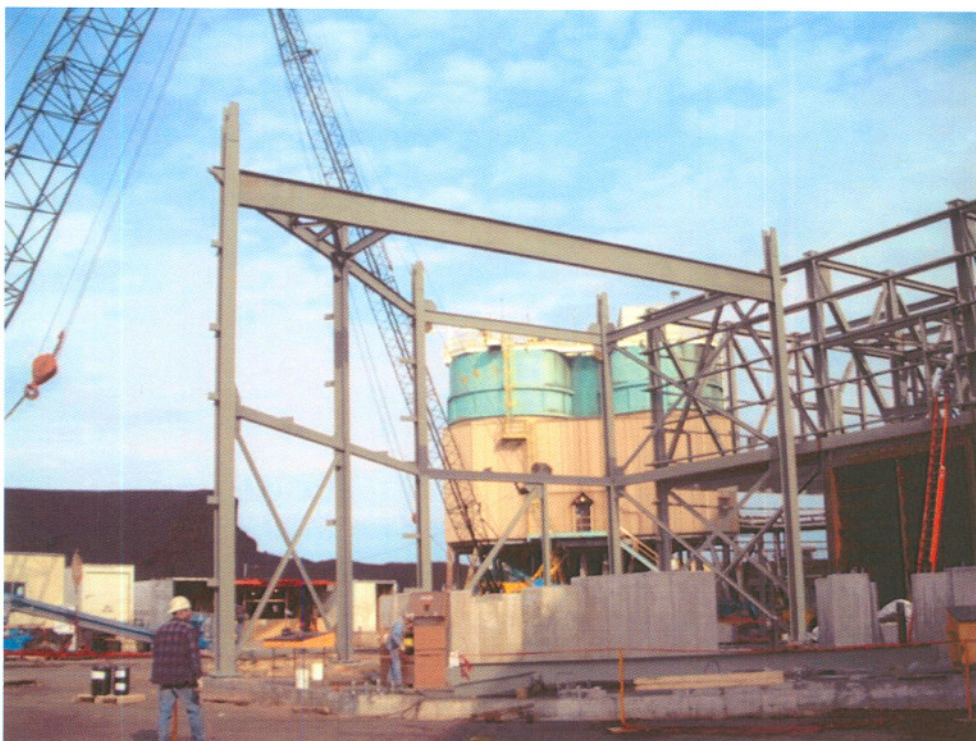


Photo 2. Erection of structural steel for fan enclosure.

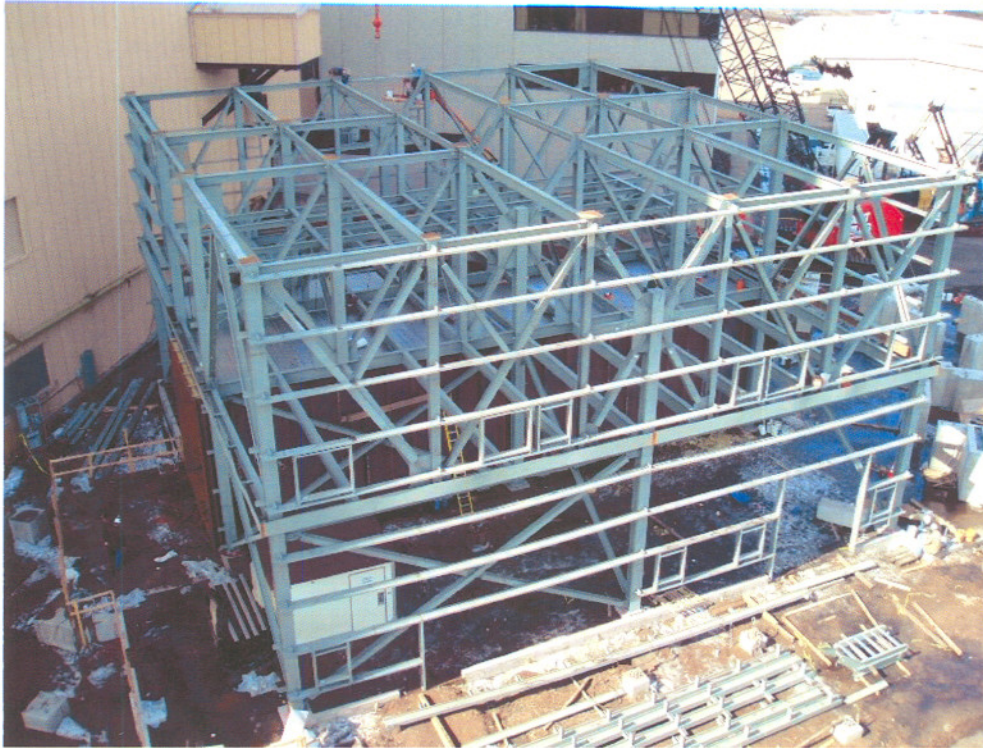


Photo 3. Erection of baghouse structural steel.



Photo 4. Delivery of Unit #8 diverter damper.

## **Appendix A - Bid Package Elements**

**480V MOTOR CONTROL CENTERS  
MEDIUM VOLTAGE STARTERS  
AIR COMPRESSOR PACKAGE  
DUCTWORK EXPANSION JOINTS  
SUPERSTRUCTURE CONSTRUCTION PACKAGE**

## 480V Motor Control Centers

### **Specification Scope**

Technical Specification 4937E3 requested a firm price to provide motor control centers consisting of an incoming line compartment, circuit breaker type combination starters, feeder circuit breakers, other equipment as specified, and spaces fully equipped to receive future units, all mounted individually in sectionalized free-standing compartments joined together to give a complete dead front assembly having a NEMA 12 enclosure with wiring accessible from the front and back.

### **Technical Evaluation Criteria**

NEMA Type Enclosure

Delivery time after receipt of order

Method of shipping and FOB point

### **Economic Cost Criteria**

Overall Price and ability to meet scheduled delivery dates

## Medium Voltage Starters

### **Specification Scope**

Technical Specification 4937E2 covers the furnishing of all labor and materials for the design, manufacture, assembly, and delivery F.O.B. freight allowed to We Energies/Presque Isle Power Plant, Marquette, Michigan, of three (3) 2.4kV (5kV class), medium voltage, three-phase, 60Hz, motor control units. These units shall be labeled for use for Units #7, #8 and #9 and shall operate, using an auto-transformer type start, non-reversing for use with 1700 HP squirrel-cage induction motors.

### **Technical Evaluation Criteria**

NEMA Type Enclosure  
Delivery time after receipt of order  
Method of shipping and FOB point

### **Economic Cost Criteria**

Overall Price and ability to meet scheduled delivery dates

## Air Compressor Package

### **Specification Scope**

Seller shall furnish materials, fabricate, test, and ship a compressed air skid. The skid shall consist of two 100% capacity rotary screw air compressors, an air receiver, desiccant air dryers with coalescing and particulate air filters, an oil water separator, and all interconnecting piping and electrical and instrumentation. The compressor package shall be mounted on a steel skid frame for installation.

### **Technical Evaluation Criteria**

Compliance with the specification  
Delivery time after receipt of order  
Method of shipping and FOB point

### **Economic Cost Criteria**

Overall Price and ability to meet scheduled delivery dates

## Ductwork Expansion Joints

### **Specification Scope**

Seller shall furnish materials, fabricate, test, and ship Expansion Joints. The materials for the expansion joints shall include flexible element belting material, insulation pillow, when required, backup bars, bolting hardware and flow liners. Expansion joints shall be furnished with all accessories necessary for a complete installation.

### **Technical Evaluation Criteria**

Compliance with the specification  
Delivery time after receipt of order  
Method of shipping and FOB point

### **Economic Cost Criteria**

Overall Price and ability to meet scheduled delivery dates

## Superstructure Construction Package

### **Specification Scope**

The following is a summary of the superstructure work for the Contractor. The Work includes but is not limited to:

- Receiving, inspecting, unloading, and placing into temporary storage, equipment and material deliveries from Owners purchase contracts.
- Install flue gas ductwork, support steel and expansion joints and dampers.
- Install miscellaneous access platforms.
- Furnish and install insulation and lagging of flue gas ductwork and other piping systems.
- Install Booster Fans and Motors with their associated lube oil skids and interconnecting piping system.
- Install the compressed air skid and associated air piping.
- Install the PAC Silo, electrical enclosure, injection piping and injection blower equipment in silo skirt.
- Install Ash Storage Silo, piping and unloading equipment.
- Install Mercury CEMS enclosure, Office Trailer, and DCS Enclosure on its foundation.
- Install Booster Fan Building support steel, platforms, stairs and metal roof deck.
- Furnish and install Booster Fan Building siding, insulation, ventilation, HVAC, louvers, doors, flashing and building penetrations, membrane roof, and other building finishes.
- Install instrumentation.
- Provide red-line markups of all construction drawings indicating as-built installation.
- Provide craft labor during startup and commissioning at hourly rates.
- Administrative and Construction Services.

### **Technical Evaluation Criteria**

Understanding and compliance with the specification

### **Economic Cost Criteria**

Overall Price and ability to meet scheduled dates

## **Appendix B - Statement of Project Objectives**

The primary goal of this project is to reduce mercury emissions from three 90-MW units at the We Energies Presque Isle Power Plant. Additional goals are to reduce nitrogen oxide ( $\text{NO}_x$ ), sulfur dioxide ( $\text{SO}_2$ ), and particulate matter (PM) emissions; allow for reuse and sale of fly ash; develop and demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment; and demonstrate a process to recover mercury captured in the sorbent. To achieve these goals, We Energies (the Participant) will design, install, and operate a TOXECON<sup>TM</sup> system designed to clean the combined flue gases of units 7, 8, and 9 at the Presque Isle Plant.

TOXECON is a patented process in which a fabric filter system (baghouse) installed downstream of an existing particulate control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. The flue gas emissions will be controlled from the three units using a single baghouse. Mercury will be controlled by injection of activated carbon or other novel sorbents, while  $\text{NO}_x$  and  $\text{SO}_2$  will be controlled by injection of sodium-based or other novel sorbents. Addition of the TOXECON baghouse will provide enhanced PM control. Sorbents will be injected downstream of the existing particle collection device to allow for sale and reuse of captured fly ash that is uncontaminated by activated carbon or sodium sorbents.

Methods for sorbent regeneration, i.e. mercury recovery from the sorbent, will be explored and evaluated. Components available for use will be evaluated and the best available will be integrated into a mercury CEM suitable for use in the power plant environment. This demonstration will provide for the use of a novel multi-pollutant control system to reduce emissions of mercury and other air pollutants, while minimizing waste, from a coal-fired power generation system.

### ***A. Project Objectives***

The specific objectives of this project are to demonstrate the operation of the TOXECON multi-pollutant control system and:

- achieve 90% mercury removal from flue gas through activated carbon injection,
- evaluate the potential for 70%  $\text{SO}_2$  control and trim control of  $\text{NO}_x$  from flue gas through sodium-based or other novel sorbent injection,
- reduce PM emission through collection by the TOXECON baghouse,
- recover 90% of the mercury captured in the sorbent,
- utilize 100% of fly ash collected in the existing electrostatic precipitator,
- demonstrate a reliable, accurate mercury CEM suitable for use in the power plant environment,
- successfully integrate and optimize TOXECON system operation for mercury and multi-pollutant control.

The Participant will design and construct a TOXECON multi-pollutant control system as a retrofit to three 90-MW coal-fired boilers at the Presque Isle Power Plant. The objectives will be achieved through injection of various sorbents into the flue gas stream to capture

mercury, SO<sub>2</sub>, NO<sub>x</sub>, and other air toxics as appropriate. Efforts will be focused on development and demonstration of two ancillary technologies, a mercury continuous emission monitor and a method of treating the captured activated carbon sorbent for regeneration or for reuse in the system rather than disposal. The demonstration project will provide the utility industry a benchmark for cost and performance of a commercial scale mercury control systems for application on coal-fired power generation systems.

### ***B. Scope of Project***

The “TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers” project will be completed in two Budget Periods. These two Budget Periods are:

Budget Period 1: Project Definition, Design& Engineering, Prototype Development, Major Equipment Procurement, and Foundation Installation.

Budget Period 2: CEM Demonstration, TOXECON Erection, TOXECON Operation, and Carbon Ash Management Demonstration.

As indicated by the title, Budget Period 1 will initiate the project with project definition activities including NEPA, followed by design, which includes specification and procurement of long lead-time major equipment, and installation of foundations. In addition, prototype development for mercury CEM and sorbent regeneration processes will be conducted.

Following in Budget Period 2, the TOXECON system will be constructed and operated. Operation will include optimization for mercury control, parametric testing for SO<sub>2</sub> and NO<sub>x</sub> control, and long term testing for SO<sub>2</sub> and NO<sub>x</sub> control. The mercury CEM and sorbent regeneration processes will be demonstrated in conjunction with the TOXECON system operation.

### ***C. Tasks to be Performed***

**(The Participant will work directly with the company identified in the parentheses.)**

**Budget Period 1: Project Definition, Design and Engineering, Prototype Development, Major Equipment Procurement, Foundation Installation, and Management and Reporting.**

Task 1 - Design Review Meeting (ADA-ES)

The project team will hold a Kickoff Design Review Meeting including the Participant, the DOE Contracting Officer’s Representative (COR), major subcontractors, and other project team members as appropriate to discuss the project, system hardware components, costs, and schedules. This meeting will take place within sixty days after award with the primary

purpose of providing a status of the ongoing work, specifying system requirements, and planning future project activities.

#### Task 2 – Project Management Plan (ADA-ES)

An updated Project Management Plan will be prepared as a deliverable within thirty days following the Design Review Meeting. This plan will be updated based on information provided at the Design Review Meeting held under Task 1. The plan will be suitable for use in tracking project progress at the task level using the earned value management system and will include the following information.

- Final Work Breakdown Structure. A final Work Breakdown Structure will be prepared that identifies Tasks and Subtasks to be performed under the project.
- Final Statement of Project Objectives. A final Statement of Project Objectives will be prepared that describes the work to be performed under the project at the Task and Subtask level of detail, following the format of the Work Breakdown Structure.
- Schedule Baseline. A Schedule Baseline will be prepared in Gantt Chart format that shows the project schedule for the entire project at the Task level of detail, including major milestones and decision points. The Schedule Baseline will follow the Task structure of the Work Breakdown Structure.
- Cost Baseline. A Cost Baseline will be prepared showing projected monthly total project cost as a function of Task, following the format of the Work Breakdown Structure.
- Technology Baseline. A description of the Baseline Technology will be prepared, including a summary of technology experience and applications, design issues to address as identified in the Design Review Meeting, mass balances, and identification of major equipment.
- Management Controls. An updated listing of key organizations and individuals involved with the project, functions and authorities of each, lines of authority, procedures used to control cost expenditures, and technical decision-making procedures.

#### Task 3 – Provide NEPA Documentation, Environmental Approvals Documentation, and Regulatory Approval Documentation (ADA-ES)

The Participant will provide a completed Environmental Information Volume and other information to DOE and any DOE-authorized subcontractors necessary to allow completion of the Environmental Assessment required for compliance with the National Environmental Policy Act (NEPA). The Participant will provide documentation to DOE demonstrating that the participant has the necessary approvals from appropriate environmental regulatory bodies to proceed with the project. The Participant will provide any rulings received from state public utilities commissions regarding this project to DOE.

#### Task 4 – Balance of Plant (BOP) Engineering (C&B)

In addition to the major process equipment, ductwork, and distributed control systems (DCS) described herein, a substantial balance of plant engineering and design effort is required. The Participant will provide BOP engineering and design necessary for the construction, installation, and operation of the TOXECON technology. The Participant will subject the BOP design to standard engineering review and acceptance procedures. The BOP engineering and design scope includes the following items.

- Demolition, excavation, and underground utility relocation design.
- Baghouse arrangement and plant equipment general arrangement design.
- Foundation design.
- Civil, structural, and ductwork design.
- Baghouse and building enclosure design.
- Mechanical design, including fans, ductwork, dampers, sorbent handling silo, and air compressors.
- Electrical system study, motor control center (MCC), and electrical design.
- Plant controls and instrumentation design, and CEM design.
- Piping and instrumentation diagrams, and piping design for carbon, water, air, sorbent/ash, and flue gas subsystems.
- Water injection skid system design.
- Carbon injection skid systems design.

For each BOP design item, the Participant will provide a definition of design scope, appropriate drawings, specifications, and instructions sufficient for the construction, installation, and operation of TOXECON system. The participant will subject the BOP design to standard engineering review and acceptance procedures.

#### Task 5 – Process Equipment Design and Major Equipment Procurement (C&B)

The Participant will provide expertise in the development of the final design and specifications for the TOXECON technology. Major equipment bid packages will be prepared and awarded in this task.

##### Subtask 5.1 – Process Equipment Design

The Participant will provide a design for the TOXECON system to be installed at the Presque Isle Plant. The Participant will provide the final design and specifications for the baghouse and sorbent injection system, which are the major components that must be integrated in the TOXECON technology. The baghouse will be capable of processing the combined flue gases of units 7, 8, and 9 at the Presque Isle Plant. The baghouse will be capable of filtering activated carbon sorbent and other sorbents used in the TOXECON system, and shall be sized appropriately such that sufficient sorbent can be injected to meet project pollution reduction goals as stated in Section A, Project Objectives. The sorbent injection system will be capable of injecting activated carbon and other sorbents in sufficient quantity to meet project pollution

reduction goals. Performance data from ongoing, non-commercial demonstrations will be included in the design as appropriate. Flow modeling will be performed to confirm design parameters. Process instrumentation necessary to track performance will be specified.

#### Subtask 5.2 – Major Equipment Procurement

Formal specifications and bid packages will be prepared, negotiated, and awarded as appropriate. Equipment packages include baghouse, demolition, and underground work; foundation, mechanical and steel; electrical and controls; sorbent silo and sorbent handling system; ID fans and motors; and air compressors.

#### Task 6 – Prepare Construction Plan (C&B)

The Participant will develop a Construction Plan that identifies and describes all crucial activities required for an on-time completion of the design, procurement, construction, and start-up phases of the project. The Construction Plan will include a Project Plan that will specify material types and quantities, labor craft requirements, and schedules necessary for the successful construction of the TOXECON system. The Construction Plan will also include a detailed Gantt chart that will identify design, procurement, construction, and start-up activity schedules with all critical path items and milestones identified. The Construction Plan Gantt chart will be used to coordinate activities among subcontractors, and to track progress of activities against a baseline schedule to assist in maintaining the project schedule.

#### Task 7 – Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment (ADA-ES)

Mercury CEM components will be selected and procured. The Participant will assess the suitability of commercially available equipment to the needs of this program. The Participant will evaluate mercury CEM components and incorporate the various components into a fully functional mercury CEM capable of measuring mercury content of a coal-fired flue gas stream suitable for evaluating performance of the TOXECON system. The mercury CEM should allow for automated operation, requiring only periodic operation and maintenance by plant operating personnel. It is a goal of this program to work with suppliers to significantly improve reliability and decrease operations and maintenance requirements of currently available mercury CEM devices. Two subtasks will be performed in Budget Period 1.

##### Subtask 7.1 – System Design, Evaluation, and Analysis (Laboratory and Field)

The Participant will evaluate mercury CEM components including the extraction, detector, calibration, sample transport, conversion and separation, and control and data management subsystems. The participant will survey existing components for availability and suitability for integration into a mercury CEM system. The participant will perform laboratory and/or field testing as appropriate of each individual subsystem to determine its suitability based on criteria stated above. The Participant will procure suitable components for system integration testing.

### Subtask 7.2 – System Integration and Testing

The Participant will integrate components procured in Subtask 7.1 into an operational mercury CEM device. The Participant will perform necessary laboratory evaluations and system checkout procedures to ensure proper operation and suitability prior to field evaluations. The Participant will develop written operating instructions for the mercury CEM system and an evaluation plan, including performance criteria, to assess mercury CEM system performance.

The Participant will perform a field evaluation at a coal-fired power generation facility to assess the performance of the mercury CEM against criteria established above according to the Evaluation Plan identified above.

### Task 8 – Mobilize Contractors (C&B)

The Participant will mobilize contractors based on the project schedule in accordance with the Construction Plan developed under Task 6. This includes construction management, demolition and excavation, mechanical, electrical, and foundation contractors. Mobilization is the first step in granting authorization for contractors to initiate work. Mobilization includes installing the temporary construction infrastructure required before crews arrive on site, hiring personnel and subcontractors, and developing a utilization plan for large equipment including cranes.

### Task 9 – Foundation Erection (C&B)

After all required demolition work, relocation of below-grade equipment, and earthwork has been completed, foundations for all major equipment will be installed. Work will be performed in accordance with design specifications developed under Tasks 4 and 5, and in accordance with the Completion Plan developed in Task 6.

The existing paved parking lot and other existing structures as required will be demolished and scrap material will be disposed of in an appropriate manner. Excavation will be performed to expose below-grade equipment and utilities, including storm pipe, trench drains, fire suppression water, and water as appropriate. These utilities will be relocated to allow for installation of the TOXECON system. New below-grade utilities required for installation and operation of the TOXECON system will be installed. General excavation will be performed to prepare for construction of foundations for all major pieces of equipment. Concrete foundations will be installed for the baghouse, sorbent injection equipment, water injection skids, and other equipment as required for the installation and construction of the TOXECON system. Roads disturbed during foundation erection will be restored, suitable for supporting access to plant operations. Large equipment will be deployed as required by the Large Equipment Deployment Plan developed in Task 8.

## Task 17 – Carbon-Ash Management System (ADA-ES)

### Subtask 17.1 – Evaluate Options and Pilot Test Carbon-Ash Management System

The Participant will evaluate the viability of a mercury recovery system for the purpose of recovering mercury from the sorbent/ash mixture and allowing for beneficial reuse of this product. The Participant will also evaluate the processed sorbent for potential reuse. This may also allow the sorbent to be recycled in the TOXECON system. Activities to be performed under this budget period will include the following. The Participant will perform a survey to identify potential technology options. From these options, a technology will be chosen for further study. The Participant will evaluate the viability of the system and approach through engineering analysis and laboratory and/or pilot scale testing.

## Task 19 – Reporting, Management, Subcontracts, Technology Transfer (ADA-ES)

The Participant will employ standard project management techniques for the purpose of keeping all activities on schedule and within the budget. Activities performed under this task will be used to provide oversight and control throughout execution of the project during Budget Period 1. The Participant will hold team meetings with attendance required from the organizations most involved during the active phase of the project to facilitate communication and enable the appropriate technical input into all activities.

The Participant will prepare and submit reports as required in the Financial Assistance Reporting Requirements Checklist and this Statement of Project Objectives. The Participant will report data such that earned value management techniques can be used to evaluate progress of Tasks under Budget Period 1. Non-proprietary technical progress reports will be distributed among team members to keep the team informed of the project status. Subcontract management, communications, outreach, and technology transfer functions will also be performed under this task.

### **Budget Period 2: CEM Demonstration, TOXECON Erection, TOXECON Operation, Carbon-Ash Management Demonstration, and Management and Reporting.**

## Task 7 – Procure Mercury CEM Package and Perform Engineering and Performance Assessment (ADA-ES)

### Subtask 7.3 – Mercury CEM Design, Component Integration, and Field Testing

Efforts to develop a mercury CEM will continue in Budget Period 2. Tasks in this period will focus on integrating components, field testing, and final design issues that have not been addressed in Subtask 7.2. Based on testing performed in Budget Period 1, overall system performance and performance of individual system components will be evaluated. Redesign of the system and individual components will be performed as required. Appropriate modifications, including acquisition and integration of new components, will be made to the prototype device to address

system deficiencies. Further laboratory evaluations, system check out, and field evaluations will be performed as required. The prototype monitor will be installed on the TOXECON system.

#### Task 10 – Erect Structural Steel, Baghouse, and Ductwork (C&B)

The Participant will construct and install structural steel, ductwork, a sorbent injection system and a baghouse necessary for the operation of the TOXECON mercury removal and multi-pollutant control system. The Participant will construct and install equipment specified and procured in Task 5 in accordance with designs developed in Tasks 4 and 5. Activities will be performed in accordance with the Completion Plan developed in Task 6.

The Participant will install structural steel necessary to support the multi-level duct arrangement, baghouse, induced draft fan enclosure, access and instrumentation supports, sorbent silo, and all other equipment necessary for operation of the TOXECON system.

Stiffened plate steel ductwork will be installed that allows flue gas from Presque Isle Units 7, 8, and 9 to enter the TOXECON baghouse or exit directly to the existing stack. Ductwork will also be installed to carry flue gas from the TOXECON baghouse, which will transition from a single duct into three, each with an induced draft fan, to carry flue gas to existing independent outlet ducts for Units 7, 8, and 9.

The Participant will install a baghouse to filter the combined flue gas streams of Units 7, 8, and 9 at the Presque Isle Plant. The baghouse shall be capable of filtering activated carbon sorbent and other sorbents used in the TOXECON system, and shall be sized appropriately such that sufficient sorbent can be injected to meet project pollution reduction goals as stated in Section A, Project Objectives.

The Participant will install steel platforms to serve as working surfaces allowing performance of standard maintenance on equipment and access to test ports and probes. These areas include access inside the existing powerhouse to the exhaust duct water injection ports, if required, and access to baghouse inlet and outlet ducts.

#### Task 11 – Balance of Plant Mechanical and Civil/Structural Installations (C&B)

The Participant will construct and install mechanical balance of plant equipment necessary for operation of the TOXECON system according to designs developed in Tasks 4 and 5, including equipment specified and procured under Task 5. Activities will be performed in accordance with the Completion Plan developed in Task 6. Balance of plant mechanical installations will include the following:

- Baghouse and duct insulation and lagging
- Hopper, fan, and silo enclosures and siding
- Sorbent/Ash vacuum exhausters skids and enclosure
- Piping, valves, support, and accessories
- Sorbent/Ash silo and unloading equipment

- Induced draft fans
- Instrument air and controls system
- Carbon injection system
- Unit tie-ins
- Heating, ventilation, air conditioning, fire protection, and support systems
- Water injection system
- Miscellaneous guard post and guardrails

#### Task 12 – Balance of Plant Electrical Installations (C&B)

The Participant will install balance of plant electrical equipment necessary for operation of the TOXECON system according to designs developed in Tasks 4 and 5, including equipment specified and procured under Task 5. Activities will be performed in accordance with the Completion Plan developed in Task 6. Balance of plant electrical installations will include the following:

- Baghouse power supply
- Three MCCs
- ID fan power supply
- Auxiliary electrical supply
- Baghouse control cable
- ID fan control cable
- Auxiliary equipment control cable
- CEMS system
- DCS system
- Freeze protection system
- Lighting system

#### Task 13 – Equipment Pre-Operational Testing (C&B)

Prior to start-up of the TOXECON system, each major and minor piece of equipment will be powered up and tested to assure that operation meets performance specifications. This includes all fans, blowers, compressors, support instrumentation, control systems, valves, dampers, and plant tie-ins. Pre-operation testing will include:

- ID fan startup and checkout
- Baghouse systems startup and checkout
- Air compressor checkout
- Carbon injection system checkout
- Sorbent/Ash handling system checkout
- Water Injection system checkout
- Instrument and controls systems checkout
- DCS programming checkout
- CEMS system checkout
- Electrical systems checkout

## Task 14 – Start Up and Operator Training (C&B)

The Participant will devote sufficient time to allow for successful start up and debugging of full system operation. The Participant will conduct operator training during the start-up period. The Participant will develop operating manuals and distribute copies to operating personnel sufficient for training and operation of the TOXECON system. Training will take place in several forms including classroom sessions for all pertinent personnel.

## Task 15 – Operate, Test, Analyze Data, and Optimize TOXECON for Mercury Control (ADA-ES)

### Subtask 15.1 – Test Plan Development

The Participant will develop Test Plans for each major area of investigation. The Participant will develop Test Plans with input from team members as appropriate. Test Plans will be subject to review by team members prior to submission to DOE for comment. The Participant will develop Test Plans for evaluating and optimizing the TOXECON technology including:

- TOXECON Evaluation
- Mercury Recovery
- Mercury CEM

The Participant shall submit a Draft Copy of each Test Plan to the DOE COR for review. The COR shall review each Test Plan and provide comments to the Participant within thirty days of receipt. The Participant shall address comments made by the DOE COR and submit a Final Copy of each Test Plan to the DOE COR for approval. The COR will provide approval of each Final Test Plan that fully addresses COR comments within thirty days of receipt. The Participant shall not initiate testing prior to completion of the Test Plan approval process.

TOXECON Evaluation Test Plan. The Participant will develop a Test Plan to evaluate mercury and multi-pollutant control through sorbent injection, and a plan to optimize TOXECON operation for maximum mercury and multi-pollutant removal under varying operating conditions. The Test Plan will address the following issues:

- A plan for start-up, optimization, long-term performance monitoring and acceptance testing of TOXECON for mercury control under varying operating conditions. Operating strategies for optimizing mercury control including but not limited to temperature control will be addressed.
- A plan and schedule for monitoring mercury entering TOXECON and mercury emissions, including demonstrating integrated operation of all subsystems and components. A plan and schedule for periodic manual stack measurements of both particulate matter and mercury. A plan and schedule for measurement of NO<sub>x</sub> and SO<sub>2</sub> emission reduction.

- Sorbents and suppliers of sorbents for mercury, NO<sub>x</sub> and SO<sub>2</sub> removal will be identified.
- A plan for evaluating fabric filter bags selected for use to determine their suitability for continued testing. Bag integrity through periodic bag strength testing, and measurement of as-received, vacuumed, and in situ bag permeability will be conducted.
- Operating data to be tracked including but not limited to temperature, pressure drop, cleaning frequency, sorbent injection rate, and opacity will be identified.
- A plan for short-term, parametric tests to evaluate alternate activated carbon sorbents and operating strategies.
- A plan for evaluating and optimizing the control of SO<sub>2</sub> and NO<sub>x</sub> through sorbent injection under varying operating conditions. A plan for investigating waste disposal and mercury recovery from these sorbents.

Mercury Recovery Test Plan. The Participant will develop a Test Plan to evaluate performance of the mercury recovery system developed under Task 17. The Participant will fully evaluate the ability of the chosen system to recover mercury from spent activated carbon sorbent and the feasibility of reuse of the sorbent in the TOXECON system. The plan will include an evaluation of methods for disposing of the mercury captured in the mercury recovery system.

Mercury CEM Test Plan. The Participant will develop a Test Plan to evaluate the performance of the mercury CEM developed under Task 7. The CEM will be evaluated on the full scale TOXECON system. The plan will be designed to evaluate the operability and reliability of the instrument. The plan will be designed to evaluate the accuracy and reproducibility of mercury emission measurements.

#### Subtask 15.2 – Optimize TOXECON for Mercury Control

The Participant will operate the TOXECON system in accordance with the TOXECON Evaluation Test Plan developed under Task 15.1. The Participant will operate the TOXECON system to evaluate its performance with respect to mercury control as a function of operating variables. The Participant will evaluate the long-term performance of the TOXECON system, and the Participant will perform short term parametric testing to evaluate alternative sorbents and operating strategies. The Participant will measure mercury emission reductions, evaluate filter bag integrity, and track operating data to quantify TOXECON performance as a function of operating conditions.

#### Subtask 15.3 – Continuous Mercury Measurements

The Participant will operate the mercury CEM to evaluate the operability, reliability, accuracy, and repeatability of the mercury CEM system in accordance with the Mercury CEM Test Plan developed in Subtask 15.1. The Participant will evaluate the performance of the mercury CEM developed under Task 7 on the full scale

TOXECON system. The mercury CEM will be used to evaluate the performance of the TOXECON system for its ability to control mercury emissions.

#### Task 16 – Operate, Test, Analyze Data, and Optimize TOXECON for SO<sub>2</sub> and NO<sub>x</sub> Control (ADA-ES)

After TOXECON operation and performance is established for mercury control, the Participant will conduct tests to assess the capability of TOXECON to control other pollutants, including SO<sub>2</sub> and NO<sub>x</sub>. Injection equipment and measurement instrumentation will be designed, procured, and installed specifically for these tests. The Participant will perform evaluations in accordance with the TOXECON Evaluation Test Plan developed in Subtask 15.1. The Participant will measure SO<sub>2</sub> and NO<sub>x</sub> emission reductions and track operating data to quantify TOXECON performance as a function of operating conditions.

#### Task 17 – Carbon-Ash Management System (ADA-ES)

##### Subtask 17.2 – Procure Full-Scale Demonstration System and Evaluate Carbon-Ash Management System

Providing that the results from Subtask 17.1 meet project goals, the Participant will procure a full-scale demonstration unit of the mercury recovery system for testing of the sorbent-ash mixture collected in TOXECON. The Participant will install the mercury recovery system on the TOXECON system to allow for continuous removal and processing of the spent sorbent and ash mixture from the TOXECON system. The Participant will perform shakedown testing to ensure proper operation of all subsystems and the integrated system as a whole prior to incorporation into the TOXECON system. The Participant will evaluate the performance of the mercury recovery system as installed on the TOXECON system in accordance with the Mercury Recovery Test Plan developed in Subtask 15.1. The Participant will evaluate the ability of the mercury recovery system to evolve mercury from used sorbent in the presence and absence of SO<sub>2</sub> and NO<sub>x</sub> sorbents. The Participant will evaluate the ability of the regenerated sorbent to capture mercury. The Participant will evaluate the methods for disposal of mercury captured in the mercury recovery system. Contingent on successful results, the Participant will provide an assessment of the capital and operating costs of the mercury recovery system and provide a cost-benefit analysis relative to inclusion of this system in the TOXECON system.

#### Task 18 – Revise Design Specifications, Prepare O&M Manuals (ADA-ES)

The Participant will prepare revisions to specifications based on the as-built installation and actual operating experience of the system. The Participant will prepare revised operating and maintenance manuals based on as-built installation and operating experience.

## Task 19 – Reporting, Management, Subcontracts, Technology Transfer (ADA-ES)

The Participant will employ standard project management techniques for the purpose of keeping all activities on schedule and within the budget. Activities performed under this task will be used to provide oversight and control throughout execution of the project during Budget Period 2. The Participant will hold team meetings with attendance required from the organizations most involved during the active phase of the project to facilitate communication and enable the appropriate technical input into all activities.

The Participant will prepare and submit reports as required in the Financial Assistance Reporting Requirements Checklist and this Statement of Project Objectives. The Participant will report data such that earned value management techniques can be used to evaluate progress of Tasks under Budget Period 2. Non-proprietary technical progress reports will be distributed among team members to keep the team informed of the project status. Subcontract management, communications, outreach, and technology transfer functions will also be performed under this task.

### ***D. Deliverables***

In addition to the reports identified on Attachment B, the Financial Assistance Reporting Requirements Checklist, and in specific sections of this agreement, the Participant shall provide documents, reports, and briefings as identified below.

**Project Management Plan.** The Participant shall provide an updated Project Management Plan within thirty days of the Design Review Meeting held under Task 1.

**Construction Plan.** The Participant shall provide a Construction Plan developed under Task 6.

**Test Plans.** The Participant shall provide the following Draft Test Plans for review by the DOE COR: Draft TOXECON Evaluation Test Plan, Draft Mercury CEM Test Plan, and Draft Mercury Recovery Test Plan. The Participant shall provide the following Test Plans for DOE approval: TOXECON Evaluation Test Plan, Mercury CEM Test Plan, and Mercury Recovery Test Plan.

**Topical Report.** The Participant shall submit a Preliminary Public Design Report as a Topical Report for Budget Period 1. The Participant shall submit a Draft Topical Report for Budget Period 1 within sixty days of the conclusion of Budget Period 1. DOE shall review the Draft Topical Report and provide comments to the Participant within thirty days of receipt. The Participant shall address DOE comments and submit a Final Topical Report for Budget Period 1 within thirty days.

**Public Design Report.** The Participant shall submit a Public Design Report, for the purpose of public use. The Public Design Report must consolidate all design and cost information for the project at the completion of construction and start up. The report must contain sufficient

information to provide an overview of the project, salient design features and data, and the role of the demonstration project in commercialization planning.

### ***E. Briefings***

Briefings and Technical Presentations shall be provided as follows.

**Kickoff Design Review Meeting.** The Participant shall hold a Kickoff Design Review Meeting as described in Task 1, within sixty days after award with the primary purpose of providing a status of the ongoing work, specifying system requirements and planning future project activities.

**Design Review Meeting.** The Participant shall hold a Design Review Meeting near the end of design activities during Budget Period 1 to present a review of the design process and salient design features of the TOXECON system.

**Final Briefing.** The Participant shall provide a Final Briefing at the conclusion of the project to provide a comprehensive summary of the accomplishments and results of this project. The location of the Final Briefing shall be Morgantown, West Virginia.